

HEATING, VENTILATION AND AIR-CONDITIONING

A student who has completed the Job Corps heating, ventilation and air-conditioning (HVAC) program is equipped with the skills to contribute to the workplace as a valued employee from day one. Competence in academic, career technical, employability and technological skills is required for graduation. To complete his or her HVAC training, a student must master the following skills:

EMPLOYABILITY SKILLS

Demonstrate the ability to dress appropriately, arrive on time and respond to supervision.

MATHEMATICAL APTITUDE

Perform and convert measurement in the inch-pound (U.S.) and metric systems; determine the powers and roots of numbers; be able to use algebra; recognize various geometric figures.

TOOLS OF THE TRADE

Identify and recognize industry tools; practice safety when using hand and power tools; know how to maintain tools of the trade.

COPPER AND PLASTIC PIPING

Identify the right tubing, the correct cut and bend for piping projects; correctly install and pressure-test the new system.

SOLDERING AND BRAZING

Know tools, precautions and preparations for soldering copper tubes and fitting; identify purposes of filler metals and fluxes used for brazing; braze copper tubing and fittings; identify inert gases that can be used to purge tubing.

FERROUS METAL PIPING PRACTICES

Identify, measure, cut, ream, thread and install all types of ferrous metal pipes.

ELECTRICITY SKILLS

Describe generation and distribution of electrical power; understand relationship between current, resistance and power; use Ohm's law and the power formula for calculations and electrical test equipment for measurements; demonstrate safety precautions; know differences between series and parallel circuits and the purpose and operation of various electrical components.

COOLING KNOWLEDGE

Understand how cooling systems and refrigeration cycles operate; calculate and take measurements to determine pressure in the refrigeration cycle; demonstrate correct use of refrigerants; identify control devices and major accessories used in cooling systems.

HEATING KNOWLEDGE

Know how heat is transferred, how combustion occurs and the products that result from combustion; identify fuels used in heating and the components of a forced-air furnace; know how oil, gas and electric furnaces work; with supervision, be able to measure pressure on gas furnaces and perform furnace maintenance.

AIR DISTRIBUTION SYSTEMS

Understand how forced air-distribution systems operate and how different fans and blowers work; install metal fileboard and flexible ducts and fittings, transitions, dampers and vapor barriers used in duct systems; make basic measurements in air distribution systems.

UNDERSTANDING CHIMNEYS, VENTS AND FLUES

Describe principles of combustion, including the difference between complete and incomplete combustion, and achieve proper combustion in a gas furnace; describe content of flue gases and how the flue is vented; identify components of a furnace vent system and describe how to select and install a vent system; understand draft control devices used for natural-draft furnaces.

SERVICE TECHNICIAN ABILITIES

Identify and install threaded and non-threaded fasteners; identify, install and remove all types of gaskets, packings and seals; know how to use lubricants and lubrication equipment; install a belt drive; install, remove and align couplings; identify types of bearings, their uses and what causes their failure; perform preventive maintenance inspections and cleaning procedures; understand customer relations.

ALTERNATING CURRENT APTITUDE

Explain how various transformers operate, alternating currents develop, phase shift occurs in inductors and capacitors and single-phase and three-phase induction motors operate; identify single-phase and three-phase wiring arrangements; describe types of capacitors and their applications; identify various types of single-phase motors and the applications; use a wattmeter, megger, capacitor analyzer, chart recorder and ohmmeter; demonstrate correct safety precautions.

ELECTRONICS KNOWLEDGE

Explain theory of electronics and semi-conductors, including how devices are used in power and control circuits; explain resistance measurements for resistors; describe operation and function of thermistors and cad cells, test semi-conductor components; identify connectors of a personal computer.

ELECTRIC HEATING COMPREHENSION

Comprehend the function of electric heating systems and electric heating controls; be able to measure resistances and check safety; calculate resistance using the temperature rise method.

CONTROL CIRCUIT TROUBLESHOOTING

Understand thermostats used in HVAC systems; know how to troubleshoot electrical problems and recognize their causes and instruments necessary for troubleshooting.

ADDITIONAL ACCESSORIES AND EQUIPMENT

Explain all methods of heat transfer and their relation to human comfort; install humidifiers and air filters and know when each is used; install and service filters used in HVAC systems; measure the friction loss of an air filter; identify accessories to improve indoor air quality and reduce energy cost.

METERING DEVICES

Explain function and operation of metering devices and expansion values, including types of thermal expansion values (TXV); understand TXV installation, adjustment and replacement.

COMPRESSORS

Identify compressors; understand how they operate; know troubleshooting procedures.

HEAT PUMPS

Identify heat pumps and their components and describe the principles of reverse-cycle heat; install and service heat pumps and refrigerant circuit accessories.

LEAK DETECTION AND SAFETY PRECAUTIONS

Identify and demonstrate common types of leak detectors; show system evacuation and dehydration; identify and demonstrate equipment used for refrigerant recovery and charging refrigerant into a system; show how to use a recycle unit.

ADVANCED LEVELS FOR HVAC TRAINING INCLUDE:

PLANNED MAINTENANCE

Develop an HVAC maintenance program; perform service and maintenance.

TROUBLESHOOTING GAS HEATING

Comprehend sequence for natural draft and induced-draft gas heating equipment; interpret control circuit diagrams and develop troubleshooting charts; isolate and correct malfunctions in gas heating systems.

TROUBLESHOOTING ELECTRIC HEATING

Explain operating principles of various types of electric heating systems including system failures; identify operating sequence of an electric heater package; understand safety precautions and potential problems associated with electric furnaces, accessory heater packages, baseboard heating systems, duct heaters and radiant heating systems.

TROUBLESHOOTING OIL HEATING

Explain operating sequence for oil-fired heating equipment; interpret control circuit diagrams and develop a troubleshooting chart; use tools needed to fix oil heating systems and state safety precautions.

TROUBLESHOOTING COOLING

Describe a systematic approach for troubleshooting cooling systems whether electrical and/or mechanical, and use proper trade tools to troubleshoot; state safety precautions.

TROUBLESHOOTING HEAT PUMPS

Interpret control circuit diagrams and develop a troubleshooting chart for heat pumps; recognize instruments to fix heat pumps; state safety precautions.

TROUBLESHOOTING ACCESSORIES

Understand troubleshooting for HVAC system accessories; isolate problems to electrical and/or mechanical functions and use the proper trade tools; state the safety precautions.

TROUBLESHOOTING ELECTRONIC CONTROLS

Compare/contrast electronic controls and conventional controls; analyze circuit diagrams to determine the operating sequence of microprocessor controlled systems; test microprocessor controlled systems.

HYDRONIC HEATING AND COOLING

Explain and identify major components of hot-water heating, steam-heating, chilled-water cooling systems and dual-temperature water systems; operate, balance and use safety precautions; describe the basic steam heating cycle; be able to install and maintain selected steam traps and perform operating procedures on low-pressure steam boilers and systems; identify common piping configurations used with the aforementioned heating systems; explain and demonstrate the procedures used in balancing a hydronic system; read the pressure across a water system circulating pump.

AIRSIDE SYSTEMS

Explain the operating principles, components and functions of commercial air systems.

AIR PROPERTIES AND AIR SYSTEM BALANCING

Explain gas laws used when dealing with air and its properties; use a psychometric chart to evaluate air properties; explain principles involved in balancing air distribution systems; understand uses of grills, registers and diffusers; balance air distribution systems; show how to change the speed of air distribution supply fans.

BLUEPRINT READING AND CONSTRUCTION DRAWING

Read and apply various types of drawings; compare mechanical plans with actual installation of duct run fittings and sections; develop cut lists for duct runs and develop elevations of installations; describe submittal, its derivation, routing and makeup; develop a field set of as-built drawings; identify steps for transferring design information to component production; develop and complete takeoff sheets; list and classify commonly used materials in HVAC systems and complete takeoff procedures for HVAC systems.

INDOOR AIR QUALITY

Explain need for good indoor air quality, evaluate air quality with proper instruments and identify causes and corrective actions that may be taken; recognize HVAC equipment that may be used to sense, control and/or enhance indoor air quality; know how to clean HVAC air system duct work and components.

ENERGY CONSERVATION EQUIPMENT

Recognize selected air-to-air heat exchanges, heat recovery systems, coil energy recovery loops, heat pipe exchanges, thermosiphon heat exchanges, twin tower enthalpy loop systems, airside and waterside economizers and steam system heat recovery systems and explain how each operates; recognize ice bank-type off-peak hours energy reduction system.

BUILDING MANAGEMENT SYSTEMS

Demonstrate familiarity with building management systems, basic direct digital controllers and control loops; recognize information available on typical front-end computer screen for building management systems; describe steps to install and know how to install a building management system in addition to typical sensors, actuators, power wiring and communication wiring.

WATER TREATMENT

Recognize the indicators for water problems, the associated remedies and explain why water treatment programs are needed; perform maintenance on HVAC equipment used to control or enhance water quality; inspect a cooling tower or evaporator condenser to test water quality; clean open recirculating water systems and relating cooling towers; demonstrate procedures used to inspect, blow down and clean boilers.

SYSTEM STARTUP AND SHUTDOWN

Prepare a boiler for dry storage and wet storage; clean, start up and shut down a steam boiler, hot water boiler, reciprocating liquid chiller, centrifugal or screw liquid chiller and air handler and related forced-air distribution system; test compressor oil for acid contamination; remove or add oil from a semi-hermetic or open reciprocating compressor; inspect and clean shell and tube condensers/evaporators and other water-type heat exchanges.

SYSTEM DESIGN KNOWLEDGE

Identify steps in the system design process; obtain information needed to complete heating and cooling load estimates from blueprints; identify causes of heat gains and losses and their effects on the design process; with instructor supervision, complete a load estimate determining the heating and/or cooling load of a building, state principles that affect equipment selection in the process, and select appropriate equipment using manufacturer's data; identify duct systems and why each is used; be able to explain the use of and install diffusers, registers and grills used in duct systems; use various charts and tables to size different types of ducts; install insulation and vapor barriers used in duct systems; select and install refrigerant and condensate piping; estimate electrical load for a building and the effect of the comfort system on the load.

COMMERCIAL AND INDUSTRIAL REFRIGERATION

Recognize various types of refrigerated coolers, their display cases and applications; compare industrial refrigeration systems with air conditioners; describe application, installation, advantages and disadvantages, and recognize single, multiple and satellite compressor systems, packaged condensing units, unit coolers and two-stage compressors; recognize and explain use of accessories used in commercial refrigeration systems and various refrigeration control devices; recognize and describe the operation and installation of ice-making machines; identify the characteristics and properties of refrigerants and oils used to replace CFC refrigerants and mineral oils; retrofit a CFC refrigeration system; recognize basic ammonia refrigeration systems and compare the components to those used in halocarbon-based refrigerant systems.